

FY2018 EPA RARE PROPOSAL

Project Title: Application of Passive Air Samplers and Spatial Analysis of Volatile Organic Compounds near Bulk Petroleum Storage Facilities in South Portland, Maine

EPA Region: 1

Regional Technical Contacts: Leiran Biton, Office of Ecosystem Protection (OEP) - 617-918-1267 biton.leiran@epa.gov; Susan Lancey, OEP - 617-918-1656 / lancey.susan@epa.gov

Regional Manager's Name and Signature: *"This is a priority area of research and the commitment of time of regional technical leads is appropriate."*

 Date: 2/2/2017
Ida E. McDonnell, Manager, OEP/Air Programs Branch - 617-918-1653

ORD Principal Investigators (PIs): Dr. Shaibal Mukerjee, Air Quality Branch (aqb), Exposure Measurement and Methods Division (EMMD), National Exposure Research Laboratory (NERL) - 919-541-1865; Donald Whitaker, aqb-EMMD-NERL - 919-541-1571

ORD Project Officer (PO)/Contracting Officer's Representative (COR): Dr. Shaibal Mukerjee

Estimated FTE effort for ORD/NERL staff: 25% (Don Whitaker, Karen Oliver), 33% (Shaibal Mukerjee)

ORD Manager's Name and Signature: *"I acknowledge the significance of ORD's role through the ORD PIs and PO involvement, the anticipated commitment of ORD staff time and resources is appropriate, and the availability of staff if the project is selected."*

 Date: 2/6/2017
Dr. Timothy Buskley, Director, EMMD/NERL - 919-541-2454

Regional Science Liaison Contact:

Date: _____
Robert Hillger, OEME/Region 1 ORD Liaison - 617-918-8660

Anticipated Start Date: April 2018

Anticipated Completion Date: April 2020

Funding Requested: \$110,000

Anticipated Funding Mechanism: Existing contracts with Jacobs Technology for lab support and sample analysis, and with Alion Science and Technology for data and statistical-based spatial analysis

ORD Research Program: Air, Climate, and Energy (ACE), Strategic Research Action Plan for 2016-2019, Objective 1: Assess Impacts, Topic 2: Emissions and Measurements (EM), Next Generation Air Monitoring (NGAM)

PROJECT SUMMARY

Statement of Problem: Traditional measurement of volatile organic compounds (VOCs)—through periodic canister grabs, for example—is expensive and results in temporal gaps in concentration readings. New, lower-cost, continuous, passive sampling techniques offer time-integrated measurements (i.e., without temporal gaps), but have been applied only around limited facility types. Furthermore, there is limited research on the effectiveness of passive air sampling techniques in colder weather climates. Finally, the extent to which bulk petroleum storage facilities (BPSFs), such as those within South Portland, Maine, may influence ambient concentrations of select VOCs (specifically benzene, toluene, ethylbenzene, and xylene isomers; i.e., BTEX compounds) is a current data gap.

Research Approach: The research team proposes to develop and analyze an air monitoring dataset for BTEX concentrations resulting from BPSFs in two phases. Phase I of the study will be to conduct passive air sampling of BTEX compounds at 15-20 locations near BPSFs in South Portland for a period of one year. Samplers will be placed near a BPSF and at points further away in the community, including near roadways. During Phase II of the study, statistical-based spatial methods and related techniques will be applied on the monitoring dataset to determine the spatially-dependent influence of BTEX levels around BPSFs. The monitoring dataset will also be correlated against meteorological data using standard statistical methods during Phase II to assess temperature effects on the passive sampling technology. And assessment of wind direction will also be included for the purposes of understanding the concentrations measured at the sampling tubes.

Anticipated Results and Regional Impact: The research team expects that spatial analysis will show BTEX concentrations to be inversely correlated with distance from BPSFs. Based on ongoing EPA studies in other parts of the country for other source sectors, differences between concentrations are expected to only be in the range of a few parts per billion. Results will indicate the extent to which BPSFs may impact air quality in South Portland, Maine, and more broadly, establish a basis for application of passive sampling in characterizing air impacts from BPSFs and in cold-weather climates.

Anticipated Final Products: The study will provide a monitoring dataset to characterize BTEX levels in South Portland, Maine that can inform local officials and stakeholders about the spatial distribution of BPSF air impacts. The study team will also prepare a manuscript for publishing results and analyses in a peer-reviewed journal, and/or develop presentation(s) for relevant scientific conferences.

PROPOSED PROJECT SCOPE

Background: In 2015, South Portland officials contacted EPA's Office of Air Quality Planning and Standards (OAQPS) to request assistance in characterizing ambient levels of air toxics around BPSFs in the city. South Portland is home to six BPSFs that store various organic liquids, including gasoline, ethanol, distillate fuels, residual fuels, asphalt, and crude oil. Marine vessels and railroad tank cars deliver organic liquids, which are piped from terminal loading sites to storage tanks and then typically loaded for distribution into pipelines and trucks, depending on the facility and product. Traditional ambient air toxics monitoring involves periodic (every sixth day) sample collection via air canister per Method TO-15¹ and provides data with significant temporal and spatial gaps. Next Generation Air Monitoring (NGAM) techniques such as arrays of passive samplers have never been used to characterize air toxics levels around BPSFs.

To address these data gaps, OAQPS and city officials discussed prospects of development of NGAM techniques similar to EPA Method 325 A/B^{2,3} for measuring air toxics around BPSFs in the city. Recent studies have established the applicability of Method 325 A/B in characterizing BTEX levels around petroleum refineries and around gas production well pads.^{4,5} EPA Region 1 staff have been in contact

¹ EPA. 1999. Air Method, Toxic Organics-15 (TO-15): Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). EPA 625/R-96/010b. https://www.epa.gov/sites/production/files/2015-07/documents/epa-to-15_0.pdf

² EPA. 2015. Method 325A-Volatile Organic Compounds from Fugitive and Area Sources: Sampler Deployment and VOC Sample Collection. 40 CFR Part 63, Subpart UUU. <http://www3.epa.gov/ttn/emc/promgate/m-325a.pdf>

³ EPA. 2015. Method 325B, *op cit*, Sampler Preparation and Analysis, *op cit*. <http://www3.epa.gov/ttn/emc/promgate/m-325b.pdf>

⁴ AP Eisele, et al. (2016) Volatile organic compounds at two oil and natural gas production well pads in Colorado and Texas using passive samplers, Journal of the Air & Waste Management Association (JAWMA), 66:4, 412-419, DOI: 10.1080/10962247.2016.1141808.

⁵ S Mukerjee, et al. (2016) Spatial analysis of volatile organic compounds in South Philadelphia using passive samplers, JAWMA, 66:5, 492-498, DOI:10.1080/10962247.2016.1147505.

with city officials and Maine DEP since early 2016 to discuss a potential monitoring study using passive samplers at BPSFs.

Project History: ORD has been engaged in the development and advancement of passive air quality monitors as part of EPA's commitment to NGAM. NGAM approaches incorporate new sampling, sensor, and informetric techniques to help improve our understanding of site-specific air quality. These techniques range from personal sensor systems to mobile inspection and fenceline monitoring approaches. NGAM technologies are designed to provide improved understanding of air pollution exposure and source emissions, help create safer working environments, and facilitate emissions reduction through advanced leak detection and other source mitigation strategies.

Consistent with NGAM, ORD has participated in several RARE-funded studies using passive air samplers. In 2009, EPA conducted a study at petroleum refineries in Corpus Christi, TX,⁶ at which benzene concentrations were found to be significantly higher for sites downwind of the refineries. In 2012 EPA conducted a study around a refinery in South Philadelphia, PA, and found that BTEX concentrations were higher at the fenceline than at more distant locations⁵. As proposed for this study, both of these prior studies used a modified version of EPA Method 325 A/B involving the deployment of passive tube samplers for consecutive 2-week periods of a year or more.

Beginning in February 2018, under the petroleum refinery NESHAPS (40 CFR 63 Subpart CC), refineries will be required to continuously monitor for benzene using consecutive, 2-week fenceline passive samplers per Method 325 A/B. For each 2-week period, facility contribution to benzene levels is calculated as the difference between the highest and lowest detected concentration. If the facility contribution on a rolling annual basis exceeds an action threshold, the refinery must identify root cause and take corrective actions.

Research Objectives: Objectives for this study include development and analysis of a spatially and temporally rich monitoring dataset that can be used to inform the key research questions.

The passive monitoring array will be deployed to characterize the spatial and temporal gradients of BTEX concentrations around a BPSF. This characterization will include a geospatial analysis of air impacts near and further away from BPSFs, and possibly assessing impacts near roadways.

Method 325 A/B currently assumes that no correction for temperature effects is necessary. This study will assess the temperature effects on passive samplers.

The study will also provide data relevant to (1) the city's interest in filling the data gap of BTEX concentrations around the BPSFs, and (2) Region 1's priorities to better characterize impacts on neighboring areas from BPSFs. Information on BTEX levels around BPSFs from the study may inform development of emission monitoring techniques for BPSFs.

Deployment at existing canister monitoring stations operated by Maine DEP at nearby Cape Elizabeth and Portland (Deering Oaks Park) will provide a regional background concentration baseline for comparison against data from South Portland. Additional 24-hour passive samplers may be deployed for direct comparison with 24-hour canister monitors for assessing the accuracy of modified Method 325 A/B.

This analysis may lead to longer term monitoring of regional air toxics levels by Maine DEP. The proposed study would provide technology transfer to Maine DEP on a relatively low-cost method for collection of VOC/air toxics data for application statewide, and as a model for use in other states.

Research Approach: The study will be organized into two phases. Phase I for planning and data collection, and Phase II for data analysis and presentation.

During Phase I, Region 1 will supply local and state partners with equipment and assist in the identification of deployment sites, in consultation with ORD PIs. Passive tube samplers using a modified

⁶ E Thoma, et al. (2011) Facility Fence-Line Monitoring Using Passive Samplers, JAWMA, 61:8, 834-842, DOI: 10.3155/1047-3289.61.8.834.

version of Method 325 A/B will be deployed at 15-20 sites at/near facility fencelines and in more distant community locations in South Portland. Passive air samplers will also be co-located at two nearby existing ambient VOC monitoring stations operated by Maine DEP. Samplers would be deployed at these sites for one year and would be housed in shelters positioned 2-4 m above ground. EPA would provide training on field deployment to City of South Portland and Maine DEP partners, who would be responsible for setting up sites with Region 1 and changing samples. After concurrent 2-week exposures to ambient air, tubes will be sent to NERL for analysis of BTEX species, and new tubes would be deployed. The study team anticipates collecting approximately 500 field samples over the course of the study. EPA would intermittently provide quality assured results with contextual analysis to study partners.

Phase II of the study will involve data processing and subsequent data analysis for spatial and temporal trends. The research team will prepare one or more manuscripts for publication in peer-reviewed journals and/or for presentation at technical conferences, and will provide a final, quality-assured dataset to Maine DEP and the city.

Research Results, Products, and Communication Plan: The study will deliver a dataset and associated geospatial and temperature analyses for one year of continuous, temporally-integrated ambient monitoring data at multiple sites at various distances from BPSFs in South Portland, Maine. The dataset and analyses will be provided to city and state partners and OAQPS. Furthermore, data collected at current Maine DEP air quality monitoring sites will allow for comparison of passive monitoring results against traditional TO-15 monitoring results.

Results from the South Portland study will yield one or more manuscripts for submission to a peer-reviewed journal and/or presentation at one or more technical conferences. These products will examine the study approach, methods used, results, spatial analysis, application of passive samplers near BPSFs, and discussion of results.

With the city and Maine DEP providing significant in-kind services, communication between EPA and our partners will be vitally important. Communication during the early stages is expected to be frequent, as sites are prepared and as the first few deployments, collection, and shipments occur. ORD and Region 1 will provide training to city and state staff on proper procedures for deploying, collecting, and shipping sampler tubes. The study team will coordinate monthly conference calls with study partners to discuss any issues that may have developed, as well as to discuss interim results.

Proposed Budget: Total Cost \$110,000

Phase I (April 2018 to April 2019): Total \$65,000

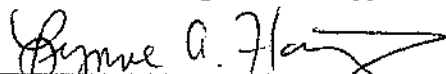
- \$15,000 - Passive sampling supplies, including samplers, sampling pods, shipping materials
- \$50,000 - QAPP and field material preparation; laboratory analysis; sample data processing

Phase II (April 2019 to April 2020): Total \$45,000

- \$10,000 - Field material preparation; lab analysis; data processing
- \$25,000 - Geospatial analysis of passive sampler concentration results
- \$10,000 - Temperature analysis of passive sampler concentration results

Project Management: Region 1 technical contacts will assist in workplan development, review and comment on the QAPP, coordinate with local and state partners, and provide input regarding any peer review. The ORD PO/PIs will initially conduct biweekly project calls with Region 1 technical contacts and the Regional Science Liaison, and subsequently conduct monthly calls to assess progress and respond to issues. Region 1 technical contacts will develop any project status reports with local and state partners.

Office Director Signature: *"I approve this proposal and agree that the project is an office priority."*


Lynne Hamjian, Acting Director, OEP

Date: 2/8/17